Medical Xpress

Babies born with broken hearts

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More than 35,000 babies are born with life-threatening congenital heart defects every year in the United States. Fetal single ventricle defects can be identified with echocardiograms. In the first months of life, surgeries can correct these defects, but tragically, about 25 percent of babies do not make it through the first surgery.

Researchers are exploring how irregular filling mechanics—the process of blood filling the heart's ventricles—may contribute to defects in developing fetal hearts because inefficient filling leads to energy losses that alter the heart's structure and performance.

Mark Payne, a pediatric cardiologist at Indiana University's School of Medicine, his colleague Pavlos Vlachos and researcher Brett Meyers from the School of Mechanical Engineering at Purdue University are exploring how filling mechanics and flow structure change over the course of gestation. During the American Physical Society's Division of Fluid Dynamics 71st Annual Meeting, which will take place Nov. 18-20 at the Georgia World Congress Center in Atlanta, Georgia, Meyers will discuss the team's findings on human fetal cardiac flow measurements collected from normal and abnormal fetal echocardiogram exams.

Advances in echocardiography have improved spatial and temporal resolution, yet more complex flow measurements such as vortex formation and intraventricular pressure remain nearly uncharted. According to Payne, the field of heart failure in children has advanced very slowly over the last 20 years.

"Existing tools to monitor heart defects have been designed for larger, slower, more regular adult hearts. They do not work as well on smaller, faster, irregular hearts," said Vlachos. The echocardiography exams this group used were performed from 20 to 35 weeks of gestation using a 2-D color Doppler reconstruction method.

Babies born with single ventricle hearts undergo a series of surgeries. "Depending on the defect, only 50 to 75 percent of children make it to the third surgery at 3 years of age," said Payne. "Children are left with one ventricle to carry them through life and after 18-25 years the single ventricle may fail, and it's still not clear why."

By looking at flow patterns in the fetal heart, Payne and his team are optimistic in furthering the field of heart failure in children. "Fetal ultrasounds have been performed for years, but we have never looked at how flow patterns affect outcome," said Vlachos.

Fluid dynamics could be used to advance the mechanistic understanding of heart failure in children, and therapies and treatments could be adjusted accordingly. According to Payne, if therapies are applied to a child who is in heart failure, a signal change in fluid dynamics could be observed to predict an outcome.

More information: Presentation Q17.10, "Tiny hearts in big trouble: cardiac flow hydrodynamics in fetal single ventricle hearts" by Brett Meyers, R. Mark Payne and Pavlos Vlachos, will be Tuesday, Nov. 20, 2:47 p.m. Room B304 of the Georgia World Congress Center in Atlanta. ABSTRACT: meetings.aps.org/Meeting/DFD18/Session/Q17.10

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